Science and engineering practices in science curricula

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ON-LINE CONFERENCE 2021

East-Asian Association for Science Education

ASIAN COLLABORATION TOWARDS THE DEVELOPMENT OF NEW SCIENCE EDUCATION FOR THE FUTURE; WISE PREPARATION WITH SDGS/STEM

Photo by Dr. Yoshisuke KUMANO

JUNE 18 (FRI) - 20 (SUN), 2021

Main Host Server: Shizuoka University, Shizuoka, JAPAN

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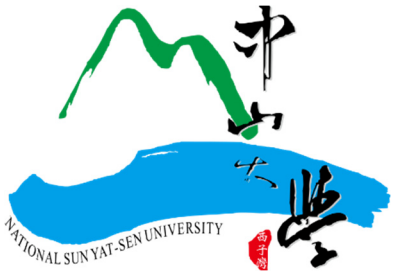

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2021 International Conference of East-Asian Association for Science Education

Greetings!! It is my great honor to announce the 2021 International Zoom Conference East-Asian Association for Science Education, Shizuoka, Japan. As all of you have known that 2020 ICEASE at Korea was canceled because of COVID 19. We are all straggling with the unbelievable difficulties in all of the activities as human beings. We are all living in the middle of historical epoch within the time of great changes of Global community.

Our theme this time is settled down as "Asian Collaboration Towards the Development of New Science Education for the Future; the Wise Preparation with SDGs/STEM" This theme has strong connection not only with the COVID 19, but also with rapid changes of Science, Technology, Engineering, Liberal Arts, and Mathematics toward SDGs. We will be able to find good solutions towards many issues that coming up globally. Those issues and problems cannot find proper solutions without good collaborations among all of the countries in the world.

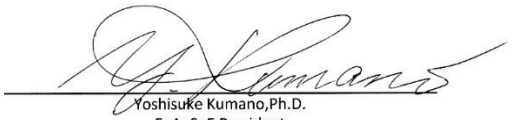
I would express my great thanks to all of the participants for 2021 International Zoom Conference EASE. Your presentations, your ideas, your questions and our discussions will be able to elaborate super solutions for the future!!

We will have six keynote speakers including myself, who will be able to provide stimulated ideas and research results for our researches in science education. I strongly wish that all of the participants should listen to their keynote speakers carefully.

Let us enjoy by joining EASE. New members and old members should attend the all-member meeting and please vote for the new president and new executive members from each region. Also, we will welcome new country members for EASE. They are the researcher from Thailand and Indonesia! Welcome to EASE!! In a near future, I would like to propose that we should upgrade the name from EASE to Asian Association of Science Education (AASE). This is one of the tasks for the New President!

Best Wishes

President of EASE, 2018-2021



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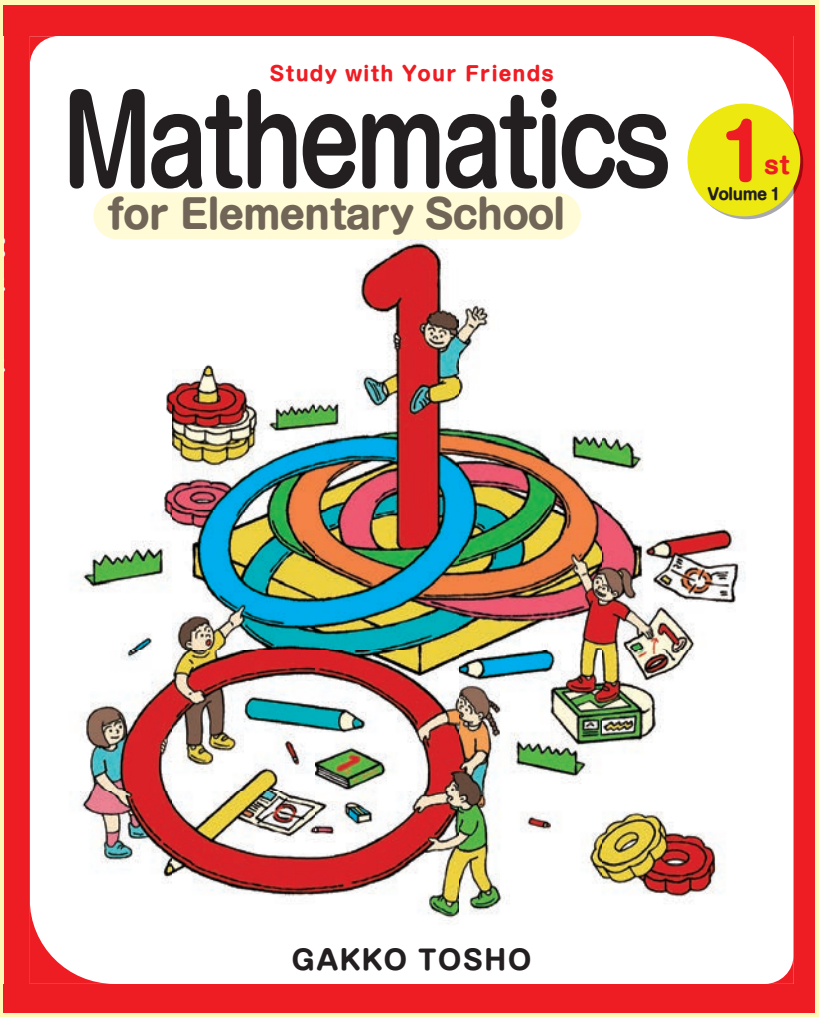

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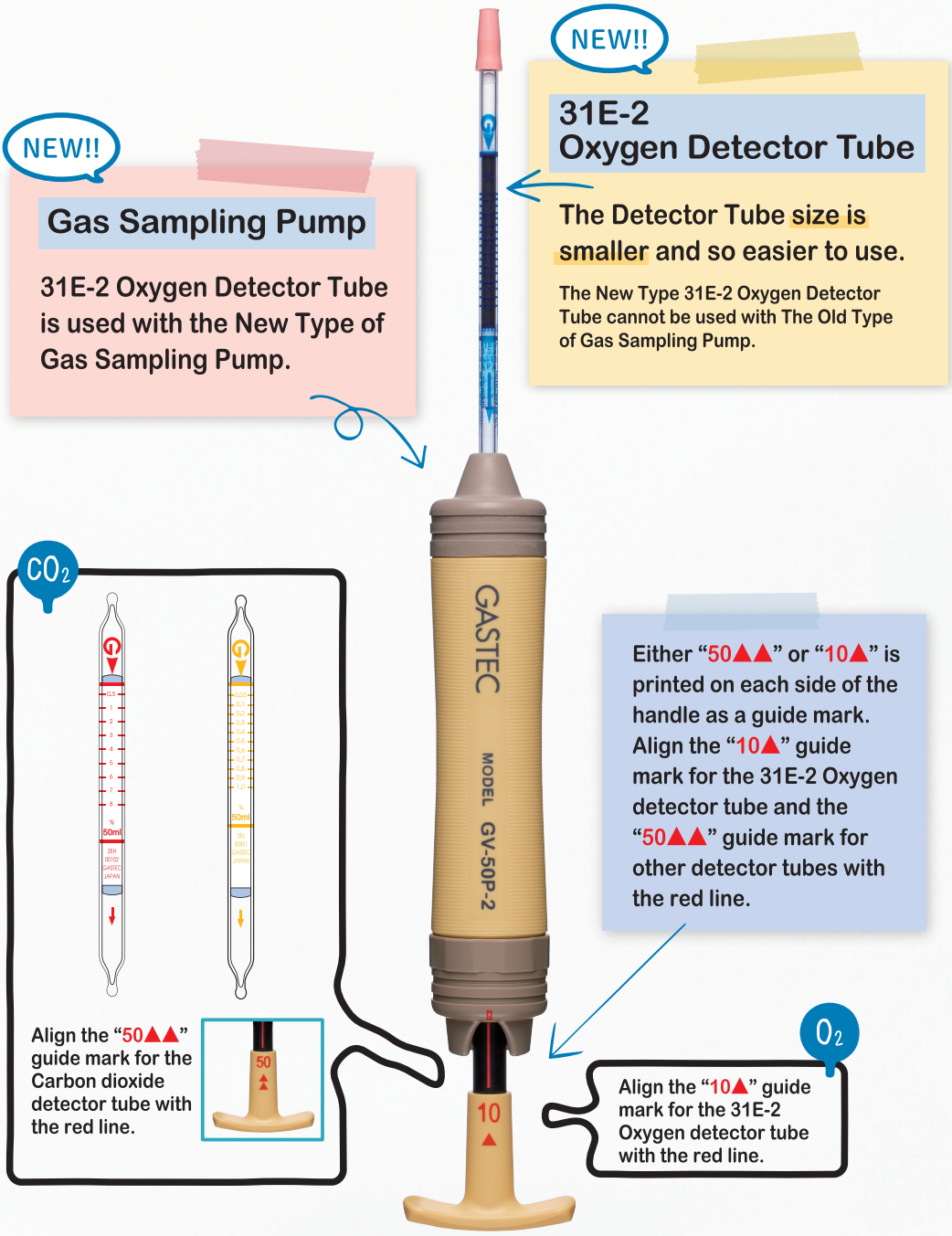

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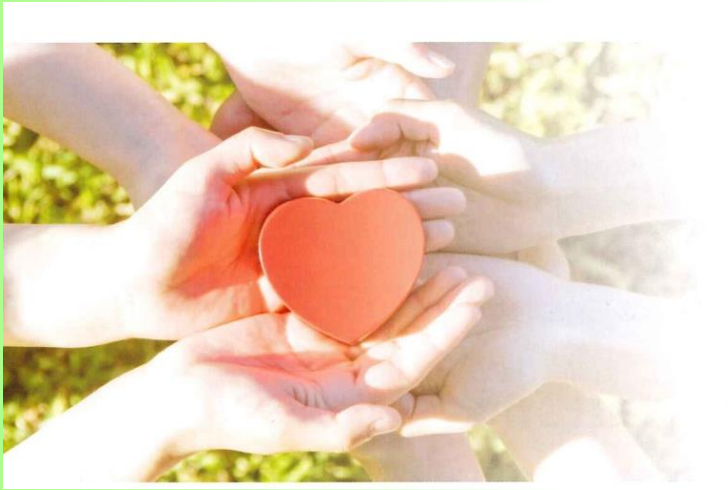

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Oral Session 5	Day3 (June20th) 13：00～14：30
Room7	C7-2

【Category】 7: Science Education for Policies and Others

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=Presentation Program=

1	117-7-2-20-1（FY62-LUMC-OF021） Chatree Faikhamta（Kasetsart University） Tharuesean Prasoplarb, Kornkanok Lertdechapat, Samia Khan, R. Ahmad Zaky El Islami, Nguyen Van Bien, Le Hai My Ngan, Song Xue, Vipawadee Kwangmek *SCIENCE AND ENGINEERING PRACTICES IN SCIENCE CURRICULA: A COMPARATIVE ANALYSIS OF THAI, VIETNAMESE, INDONESIAN AND SCOTTISH CURRICULA*
2	118-7-2-20-2（FY5E-MNM2-VD021） Young-Shin Park（Chosun University） Gyu-Jin Hwang *The Development of the Global Energy STEAM program for Cultivating democratic citizen's literacy and its implication in science education*
3	119-7-2-20-3（FY6W-KDQ5-T9021） Yue-jiong Su（Taiyuan No.61 Middle School） Guo-feng Zhang, Wen-hua Zhang, Zu-hao Wang *Research on the mechanism of integrating PCK knowledge between high school chemistry novice teachers and experiential teachers*

SCIENCE AND ENGINEERING PRACTICES IN SCIENCE CURRICULA: A COMPARATIVE ANALYSIS OF THAI, VIETNAMESE, INDONESIAN AND SCOTTISH CURRICULA

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1. *Kasetsart University, Bangkok, Thailand*
2. *University of Dundee, Dundee, United Kingdom*
3. *Universitas Sultan Ageng Tirtayasa, Serang, Indonesia*
4. *Hanoi National University of Education, Hanoi, Vietnam*

ABSTRACT

Science and engineering practices (SEPs) are one of the key learning goals of Science, Technology, Engineering, and Mathematics (STEM) education. There are few studies that compare similar SEPs in the science curricula of different countries. This study aims to compare SEPs in the science curricula of four countries (Indonesia, Scotland, Thailand, and Vietnam) in order to ascertain common knowledge and skills. Content analysis was used to analyse learning outcomes for grades seven to nine. The results showed that 1) desired learning outcomes in all four countries were consistent with science practices rather than with engineering practices and that they did not cover a number of SEPs. "Constructing scientific explanations" was found to have the highest frequency of the SEPs addressed in the curricula of the four countries, while "asking questions and defining problems" had the lowest overall average frequency. "Developing a model" was found more frequently in the Thai curriculum than in the Indonesian, Scottish, or Vietnamese curricula. The results of this study suggest that curriculum developers interested in broadening practices associated with science might revisit learning outcomes for the science curriculum in the areas of modelling and asking questions. Further research into the science curriculum could compare science or mathematics learning outcomes with the core disciplinary ideas, crosscutting concepts and the nature of each discipline, that are foundational in STEM education. Moreover, it would be worthwhile to investigate curriculum implementation of these practices by assessing teachers' instruction and students' STEM literacy.

INTRODUCTION

In response to the need for more curricular research in the area of STEM education, the present comparative study attempts to highlight the similarities and differences between countries regarding their Science and Engineering Practices (SEPs) suggested by US NGSS (Lead States, 2013). The main objective of this study was to compare the SEPs in the science curricula of four countries; Indonesia, Scotland, Thailand, and Vietnam. The four countries included in this study represent two distinct regions and historically divergent cultures: Scotland and Southeast Asia. Both also reflect the richness of a rapidly transforming educational system linked to new emerging economic power. These differences and similarities make it interesting to evaluate the links, spatial patterns, and differences within and across curricula.

RESEARCH METHODOLOGY

Following an interpretive paradigm (Cresswell and Miller, 2000), this research represents a comparative case study of science curricula. For the sake of comparison, the SEPs addressed in NGSS standards were used to inform the development of an initial practice framework. We aimed to build a nuanced understanding of the individual curricula in terms of their SEP practices. Care was taken to present the basis for SEP inclusion from a country-context perspective and not to present these practices as deviating from a supposed standard measure (e.g. the NGSS). Since learning outcomes in some countries are divided into a series of very short sentences or bulleted phrases, details of each curriculum were broken down into sub-SEPs, so that the learning outcomes could be classified and identified more clearly via content analysis.

CONCLUSION AND DISCUSSIONS

Our quantitative analysis revealed that Thailand and Vietnam had a greater number of total sub-SEPs than either Indonesia or Scotland in their science curriculum. Since Thailand, Vietnam, and Indonesia had newly revised their curriculum at the time of this analysis. The aims strongly emphasized students' authentic problem-solving and 21st century skills, and this emphasis may have resulted in many SEPs being included in the curriculum. Compared with Southeast Asian countries, the Scottish curriculum did not have as many SEP learning outcomes. The SEP, 'constructing scientific explanations and designing engineering solutions' was the most common SEP and was among the top three in all countries' 7-9 science curricula. In the Thai curriculum, the SEP was ranked first (32%), followed by the Vietnam curriculum, where it was ranked second (25%) as it was in the Scottish curriculum (23%); whereas it ranked third in the Indonesian curriculum (9%). Another SEP that all four countries emphasised was the third: 'planning and carrying out investigations'. Since all the countries have developed their curriculum based on the STEM approach, the engineering design process has been addressed as one of the key ideas. Teaching science is more integrated and engineering solutions inherently appeared to address real-world problems (NRC, 2014). Besides, Biology had Rich-SEPs in all four countries, while Physics and Chemistry had Rich-SEPs in three countries, excluding Scotland and Indonesia, respectively Even though space science was a topic in all of the countries in terms of SEPs, it had the most Some-SEPs, evident across three of the countries, with the exception of Vietnam, which but No-SEPs in this strand. Earth Science was similar, with all countries having Some-SEPs except Scotland, which had Rich SEPs. Only two strands, in two countries, showed No-SEPs; these were Astronomy in Vietnam's curriculum and Technology in Scotland's curriculum.

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